

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>N.75570A SLS</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/GB 00/00861</b>	International filing date (day/month/year) <b>09/03/2000</b>	(Earliest) Priority Date (day/month/year) <b>09/03/1999</b>
Applicant <b>ISIS INNOVATION LIMITED et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2.  Certain claims were found unsearchable (See Box I).

3.  Unity of Invention is lacking (see Box II).

4. With regard to the title,

the text is approved as submitted by the applicant.

the text has been established by this Authority to read as follows:

5. With regard to the abstract,

the text is approved as submitted by the applicant.

the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

2

None of the figures.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP 00/00861

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7 H01P5/16

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>BOIFOT A M: "CLASSIFICATION OF ORTHO-MODE TRANSDUCERS" EUROPEAN TRANSACTIONS ON TELECOMMUNICATIONS AND RELATED TECHNOLOGIES, IT, AEI, MILANO, vol. 2, no. 5, 1 September 1991 (1991-09-01), pages 35-42, XP000266379 ISSN: 1120-3862 page 41, right-hand column, line 25 -page 42, left-hand column, line 4; figure 13 ----</p>	1
A	<p>US 4 853 650 A (BOWLING ET AL.) 1 August 1989 (1989-08-01) column 6, line 1 - line 24; figure 6 ----</p>	1
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

18 May 2000

Date of mailing of the international search report

26/05/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Den Otter, A

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00861

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 263 612 A (THOMSON-CSF) 3 October 1975 (1975-10-03) page 6, line 1 - line 13; figures 2,3 -----	1
A	US 2 420 354 A (CARTER) 13 May 1947 (1947-05-13) column 5, line 36 -column 6, line 2; figures 4,6 -----	1

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

/GB 00/00861

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US 4853650	A 01-08-1989	NONE		
FR 2263612	A 03-10-1975	FR 2182728 A		14-12-1973
		BE 826386 A		30-06-1975
		DE 2510033 A		11-09-1975
		GB 1464078 A		09-02-1977
		IT 1056100 B		30-01-1982
		JP 50122847 A		26-09-1975
		JP 1264817 C		27-05-1985
		JP 57164601 A		09-10-1982
		JP 59044801 B		01-11-1984
		US 3943519 A		09-03-1976
		BE 798975 A		31-08-1973
		DE 2322549 A		15-11-1973
		GB 1362946 A		07-08-1974
		JP 49056560 A		01-06-1974
		NL 7306157 A		07-11-1973
		US 3816835 A		11-06-1974
US 2420354	A 13-05-1947	US 2337184 A		21-12-1943

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>N.80151B SLS</b>	<b>FOR FURTHER ACTION</b> <small>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</small>	
International application No. <b>PCT/GB 01/ 04047</b>	International filing date (day/month/year) <b>10/09/2001</b>	(Earliest) Priority Date (day/month/year) <b>11/09/2000</b>
Applicant <b>ISIS INNOVATION LIMITED</b>		

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the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

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as suggested by the applicant.

because the applicant failed to suggest a figure.

because this figure better characterizes the invention.

2

None of the figures.



The  
Patent  
Office

19

Application No: GB 9808703.4  
Claims searched: 1-16

Examiner: Peter Emerson  
Date of search: 5 October 1998

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H3U UQX; H1W-WCX, WBA, WBX

Int Cl (Ed.6): H03H 7/00, 7/46, 7/48; H01P 5/04, 5/12

Other: Online: WPI, JAPIO, CLAIMS

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
Y	GB 2204186 A (TOKYO) - figs 2, 4, 5(1), 5(3)	1, 4-6, 9-11
Y	GB 2158295 A (MITSUBISHI) - fig 1.	4-6, 9-11
Y	US 5469129 A (MOTOROLA) - figs 1-4, col 2 line 62-col 3 line 14.	1, 4-6, 11

X Document indicating lack of novelty or inventive step  
Y Document indicating lack of inventive step if combined with one or more other documents of same category.  
& Member of the same patent family

A Document indicating technological background and/or state of the art.  
P Document published on or after the declared priority date but before the filing date of this invention.  
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

## TENT COOPERATION TRE

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION  
(PCT Rule 61.2)

Date of mailing (day/month/year)  
22 November 2000 (22.11.00)

To:  
Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

International application No. PCT/GB00/00861	Applicant's or agent's file reference N.75570A SLS
International filing date (day/month/year) 09 March 2000 (09.03.00)	Priority date (day/month/year) 09 March 1999 (09.03.99)
Applicant EDWARDS, David, John et al	

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:  
04 October 2000 (04.10.00)

in a notice effecting later election filed with the International Bureau on:  
\_\_\_\_\_

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer  Zakaria EL KHODARY  Telephone No.: (41-22) 338.83.38
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## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference N.75570A SLS	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/00861	International filing date (day/month/year) 09/03/2000	Priority date (day/month/year) 09/03/1999
International Patent Classification (IPC) or national classification and IPC H01P5/16		
Applicant ISIS INNOVATION LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I  Basis of the report
- II  Priority
- III  Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV  Lack of unity of invention
- V  Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand 04/10/2000	Date of completion of this report 18.06.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Van der Peet, H Telephone No. +49 89 2399 2764



INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

International application No. PCT/GB00/00861

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):  
Description, pages:

1-4,6,7,10,12	as originally filed		
5,8,9,11	as received on	06/02/2001 with letter of	05/02/2001

Claims, No.:

1-12	as originally filed
------	---------------------

Drawings, sheets:

1/3,2/3	as originally filed		
3/3	as received on	06/02/2001 with letter of	05/02/2001

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/00861

4. The amendments have resulted in the cancellation of:

- the description,        pages:
- the claims,           Nos.:
- the drawings,        sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability**

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- the entire international application.
- claims Nos. 1-12.

because:

- the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):
- the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 1-12 are so unclear that no meaningful opinion could be formed (*specify*):  
**see separate sheet**
- the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- no international search report has been established for the said claims Nos.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

- the written form has not been furnished or does not comply with the standard.
- the computer readable form has not been furnished or does not comply with the standard.

**VII. Certain defects in the international application**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/00861

The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/00861

In order to facilitate easy reference the documents cited in the International Search Report are numbered *seriatim* D1 to D4.

1. As already set out in the Written Opinion two sets of figures reached the file, to wit:
  - a) a three page set
    - 1/3: showing figures 1, 4, and 5,
    - 2/3: showing figures 2 and 3,
    - 3/3: showing figures 7 and 8 and
  - b) a five page set
    - 1/5 showing figure 1,
    - 2/5 showing figure 2,
    - 3/5 showing figure 3,
    - 4/5 showing figures 4 and 5,
    - 5/5 showing figures 7 and 8.

It is accordingly clear that figure 6 is missing from both sets of figures.

In response to the respective observations in the Written Opinion the applicants submitted that the content of figure 6 was not significant to an understanding to the invention and the description on page 9 equally applies to figure 2. According to the original description on page 8 lines 31-33, figure 6 is the basis for a "broader description of the principles behind the present invention" whereas figure 2 merely illustrates an embodiment of the present invention. It is accordingly maintained that a proper understanding of the principles behind the invention requires an understanding of figure 6, which is missing from the file. In this respect a renewed reference to figure 2 is of no assistance and the amended description on present page 8, line 31 to page 10, line 27 now referring to figure 2 is hence not supported by the application as first filed and therefore offends the proscription of Article 34(2)b, last sentence.

2. On page 6 of the description it is pointed out that "by choosing appropriate frequencies, dimensions and properties of the DMC, it is also arranged that the standing wave produced by one of the pair of inputs has no effect on the other pair of inputs". It is unclear what "effect" is referred to. It is furthermore unclear what "properties of the DMC" are meant. It is accordingly impossible for the skilled

INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET

International application No. PCT/GB00/00861

man to identify the technical problem hinted at by "effect on the other pair of inputs". It is furthermore unclear what technical criterium renders "appropriate" "frequencies", "dimensions" or "properties of the DMC". It is consequently impossible for the skilled man to know the solution to the technical problem and to carry out the invention (Rule 5.1(a)iii). In this respect it is noted that also independent claims 1 and 12 merely present a *desideratum* i.e. an output must be positioned such as to receive power from the first and second standing waves.

The applicants submitted in this respect that this view ignores the essence of the present invention i.e. the recognition that the prior art problem can be overcome by the use of standing waves because any input to "node positions" will have "no affect on the standing wave".

However, neither claim 1 nor claim 12 refers to "node positions". The description on page 7 (lines 6-9) states in respect of the figure 3 embodiment that the "DMC is arranged such that the waves from both of the pairs of inputs create an anti-node at the centre of the DMC", without specifying the nature of the anti-node (voltage, current). The submission is accordingly rejected.

Both claims 1 and 12 refer to a "wave device" without defining or specifying the constituent parts of the device (apart from inputs and an output). Hence the claims fail to indicate the technical features with which the *desideratum* is accomplished. Therefore the claims do not conform to the requirement of Rule 6.3(a).

3. For the reasons set out above any opinion of novelty and inventiveness of the claims currently on file appears to be unduly speculative.

It is, however, observed that the Class IVb OMT known from figure 13 of document D1 appears to be readable onto the DMC shown in figures 2 and 3 of the present application. The known DMC (OMT) has a power splitter EH20 connected to a first pair of horizontal inputs suitable for setting up a first standing wave therebetween and a power splitter EV20 connected to a second pair of vertical inputs suitable for setting up a second standing wave therebetween and positioned such that the input signal of each of the first and second pairs of inputs is unaffected by the state or impedance of the other of the first and second pairs of inputs (as is usually the case with OMT's); and an output (circular waveguide) positioned so as to receive power from both the first and second standing waves.

-5-

waves.

5 In this way, the combiner may combine three or more signals, with each signal being independent of the other signals and not effecting the input impedance.

10 The wave device may also be used as a splitter by providing a power input at the output of the wave device and receiving divided power output from the pairs of inputs.

15 The invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a known 2-way Wilkinson combiner;

Figure 2 illustrates an embodiment of the present invention;

20 Figure 3 illustrates a cross-section through the embodiment of Figure 2;

Figure 4 illustrates the microstrip layer of a divider;

25 Figure 5 illustrates a microstrip layer of a matching circuit;

Figure 6 illustrates a schematic construction of an embodiment of the present invention;

30 Figure 7 illustrates the frequency response of an embodiment of the present invention with both amplifiers working and with a failed amplifier; and

Figure 8 illustrates a frequency response of an embodiment of the present invention with both amplifiers working and with a failed amplifier.

35 An embodiment of a 2-way combiner will now be

-8-

Any suitable material may be used for the dielectric 30. Indeed, if the plate 28 is appropriately supported, for instance by means of its connecting pins, then the dielectric 30 may be a gas, such as air, or indeed free  
5 space.

It is also contemplated to base the device on Gallium Arsenide or such like and thereby allow production using integrated circuit techniques.

10

As illustrated, the output 20 is taken through the dielectric and also through and insulated from the support structure 32. Although not illustrated, a similar arrangement is provided for the inputs. These  
15 connect to the periphery of the plate 20, whilst being insulated from the support structure 32. Any ground line of the wave guides for the inputs, for instance the shielding of a coaxial cable, may be connected to the support structure 32.

20

The embodiment discussed above used a DMC of circular structure having two pairs of inputs and a centrally mounted output. However, as will be apparent from the following, such a structure is not necessary for  
25 application of the present invention. For instance, when using two pairs of inputs with perpendicular standing waves, the DMC, or at least the plate 28 in the microstrip embodiment, can be square with inputs mounted centrally along respective edges of the square.

30

Referring to Figure 6, a broader description of the principles behind the present invention will be described.

35

By applying a signal to both inputs 34,36 across a

-9-

device 38, it is possible to set up a standing wave across the device 38. The nature of that standing wave will vary according to the frequency of the input signal, the distance between the two inputs and the properties of 5 the wave device 38. In particular, the resonant frequency between the inputs will depend on the distance between them and, for the embodiment of Figure 3, the dielectric constant of the dielectric 30. For the same resonant frequency, the size of the device will be reduced as the 10 dielectric constant increases.

When a standing wave exists between the inputs 34, 46, the signal which can be detected at the periphery of the device 38 varies around the periphery. When the 15 standing wave between the inputs 34, 36 is at the fundamental frequency, then the detected signal at the periphery of the device 38 reaches a minimum of substantially zero at a position halfway between the inputs 34 and 36. Thus, for a 2-way combiner, it is 20 sufficient to connect a second pair of inputs perpendicular to the first pair of inputs. It will be noted that, in this case, with two perpendicular standing waves, it is therefore sufficient for the device 38 to be square.

25

By changing the operating frequency of the device or alternatively changing the size or the properties of the device, it is possible to set up different standing waves. In particular, it is possible to set up standing 30 waves such that the detected signal at the periphery reaches substantially zero at multiple points around the periphery. In this way, it is possible to arrange three or more pairs of inputs around the periphery to provide a 35 three or more-way combiner. Indeed, the device may then be any even sided polygon such as a hexagon, octagon etc.

-11-

outputs from the Wilkinson divider. DMCs were initially simulated with both amplifiers working and then with one of the amplifiers failing. A failed amplifier was defined according to the worst case, namely (i) zero 5 output power and (ii) the impedance of the failed amplifier, as seen from the divider, ranging from zero to infinity i.e. anything between short circuit to ground and an open circuit. The results of the test are illustrated in Figures 7 and 8. The output power from a 10 working amplifier is one unit and the results obtained include the losses incurred by the Wilkinson divider, which has an efficiency of 90%.

Referring to Figure 7, using a 2-way Wilkinson 15 divider for the first stage and a centre frequency of 1.8 GHz, it will be seen that, for both amplifiers working, the total combining efficiency at the centre frequency was 80%, with the worst efficiency within the operational band width being 78%. Similarly, for a single amplifier 20 failure, the total combining efficiency at the centre frequency was 63% and the worst efficiency within the operational band width was 59%.

For the second case, illustrated in Figure 8 25 utilising a 4-way Wilkinson divider and a centre frequency of 1.83 GHz, it will be seen that for both amplifiers the total combining efficiency at the centre frequency was 80% and the worst efficiency within the operational band width was 80%. Similarly, for a single 30 amplifier failure, the total combining efficiency at the centre frequency was 63% and the worst efficiency within the operation band width was 54%.

In conclusion, it will be seen that the simulation 35 results obtained show that the DMC has an efficiency

3/3

Fig.7.

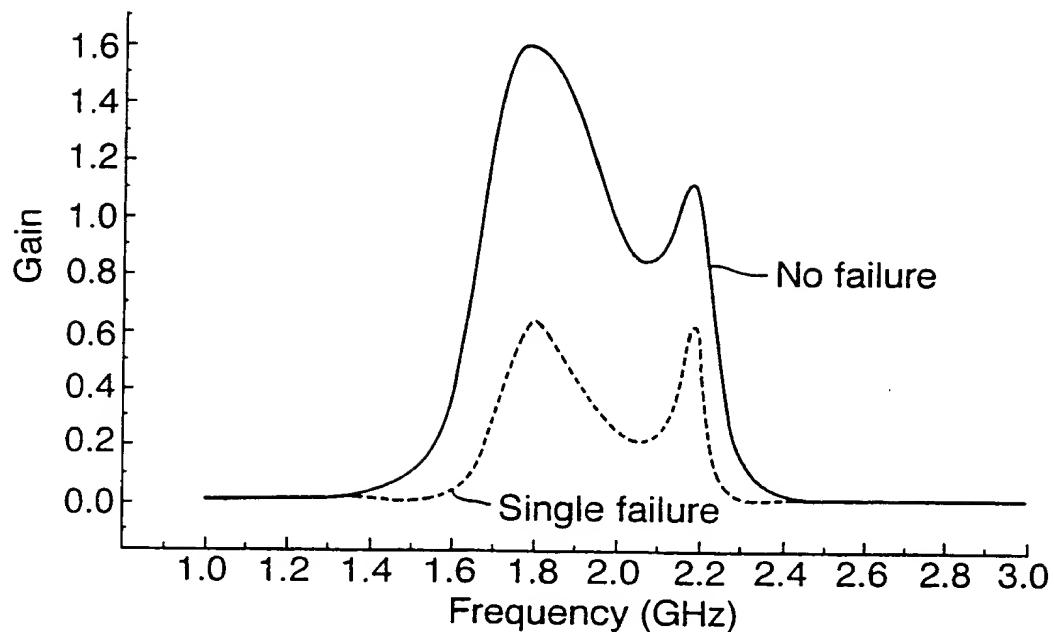
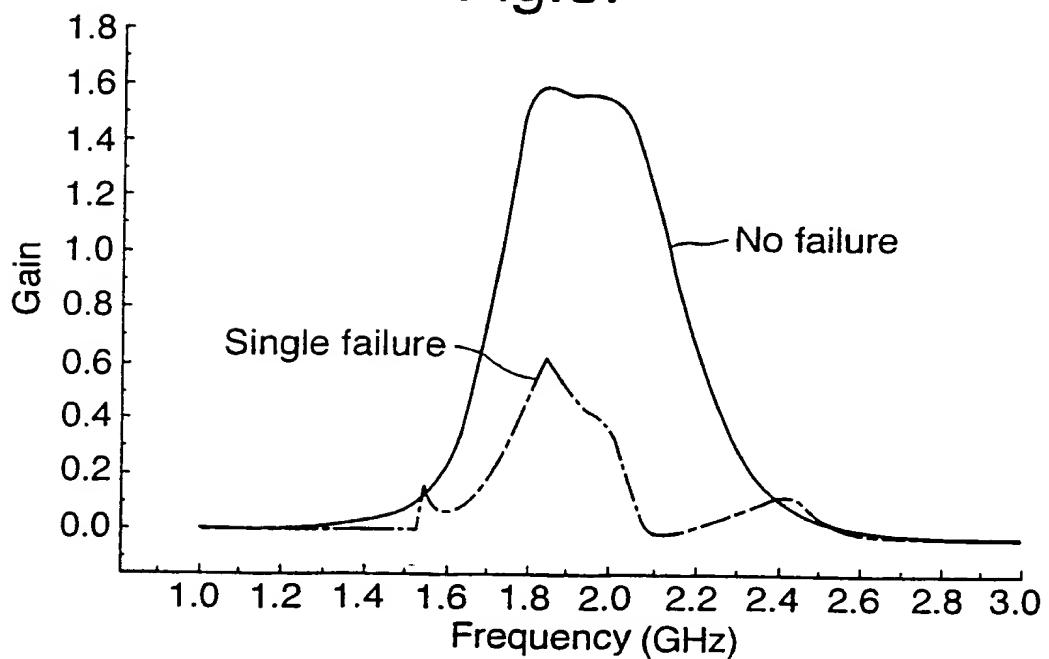


Fig.8.



PCT

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

## (PCT Article 36 and Rule 70)

3

Applicant's or agent's file reference N.75570A SLS	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/00861	International filing date (day/month/year) 09/03/2000	Priority date (day/month/year) 09/03/1999	
International Patent Classification (IPC) or national classification and IPC H01P5/16			
Applicant ISIS INNOVATION LIMITED et al.			

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- VI  Certain documents cited
- VII  Certain defects in the international application
- VIII  Certain observations on the international application

Date of submission of the demand 04/10/2000	Date of completion of this report 18.06.2001
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer  Van der Peet, H Telephone No. +49 89 2399 2764



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/GB00/00861

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17):*  
**Description, pages:**

1-4,6,7,10,12      as originally filed

5,8,9,11      as received on      06/02/2001 with letter of      05/02/2001

**Claims, No.:**

1-12      as originally filed

**Drawings, sheets:**

1/3,2/3      as originally filed

3/3      as received on      06/02/2001 with letter of      05/02/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- the language of publication of the international application (under Rule 48.3(b)).
- the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- contained in the international application in written form.
- filed together with the international application in computer readable form.
- furnished subsequently to this Authority in written form.
- furnished subsequently to this Authority in computer readable form.
- The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

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4. The amendments have resulted in the cancellation of:

- the description,      pages:
- the claims,           Nos.:
- the drawings,        sheets:

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

## III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

- the entire international application.
- claims Nos. 1-12.

because:

- the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):
- the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 1-12 are so unclear that no meaningful opinion could be formed (*specify*):  
**see separate sheet**
- the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.
- no international search report has been established for the said claims Nos. .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

- the written form has not been furnished or does not comply with the standard.
- the computer readable form has not been furnished or does not comply with the standard.

## VII. Certain defects in the international application

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The following defects in the form or contents of the international application have been noted:  
**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:  
**see separate sheet**

In order to facilitate easy reference the documents cited in the International Search Report are numbered *seriatim* D1 to D4.

1. As already set out in the Written Opinion two sets of figures reached the file, to wit:

a) a three page set

1/3: showing figures 1, 4, and 5,

2/3: showing figures 2 and 3,

3/3: showing figures 7 and 8 and

b) a five page set

1/5 showing figure 1,

2/5 showing figure 2,

3/5 showing figure 3,

4/5 showing figures 4 and 5,

5/5 showing figures 7 and 8.

It is accordingly clear that figure 6 is missing from both sets of figures.

In response to the respective observations in the Written Opinion the applicants submitted that the content of figure 6 was not significant to an understanding to the invention and the description on page 9 equally applies to figure 2. According to the original description on page 8 lines 31-33, figure 6 is the basis for a "broader description of the principles behind the present invention" whereas figure 2 merely illustrates an embodiment of the present invention.

It is accordingly maintained that a proper understanding of the principles behind the invention requires an understanding of figure 6, which is missing from the file. In this respect a renewed reference to figure 2 is of no assistance and the amended description on present page 8, line 31 to page 10, line 27 now referring to figure 2 is hence not supported by the application as first filed and therefore offends the proscription of Article 34(2)b, last sentence.

2. On page 6 of the description it is pointed out that "by choosing appropriate frequencies, dimensions and properties of the DMC, it is also arranged that the standing wave produced by one of the pair of inputs has no effect on the other pair of inputs". It is unclear what "effect" is referred to. It is furthermore unclear what "properties of the DMC" are meant. It is accordingly impossible for the skilled

man to identify the technical problem hinted at by "effect on the other pair of inputs". It is furthermore unclear what technical criterium renders "appropriate" "frequencies", "dimensions" or "properties of the DMC". It is consequently impossible for the skilled man to know the solution to the technical problem and to carry out the invention (Rule 5.1(a)iii). In this respect it is noted that also independent claims 1 and 12 merely present a *desideratum* i.e. an output must be positioned such as to receive power from the first and second standing waves.

The applicants submitted in this respect that this view ignores the essence of the present invention i.e. the recognition that the prior art problem can be overcome by the use of standing waves because any input to "node positions" will have "no affect on the standing wave".

However, neither claim 1 nor claim 12 refers to "node positions". The description on page 7 (lines 6-9) states in respect of the figure 3 embodiment that the "DMC is arranged such that the waves from both of the pairs of inputs create an anti-node at the centre of the DMC", without specifying the nature of the anti-node (voltage, current). The submission is accordingly rejected.

Both claims 1 and 12 refer to a "wave device" without defining or specifying the constituent parts of the device (apart from inputs and an output). Hence the claims fail to indicate the technical features with which the *desideratum* is accomplished. Therefore the claims do not conform to the requirement of Rule 6.3(a).

3. For the reasons set out above any opinion of novelty and inventiveness of the claims currently on file appears to be unduly speculative.

It is, however, observed that the Class IVb OMT known from figure 13 of document D1 appears to be readable onto the DMC shown in figures 2 and 3 of the present application. The known DMC (OMT) has a power splitter EH20 connected to a first pair of horizontal inputs suitable for setting up a first standing wave therebetween and a power splitter EV20 connected to a second pair of vertical inputs suitable for setting up a second standing wave therebetween and positioned such that the input signal of each of the first and second pairs of inputs is unaffected by the state or impedance of the other of the first and second pairs of inputs (as is usually the case with OMT's); and an output (circular waveguide) positioned so as to receive power from both the first and second standing waves.

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waves.

In this way, the combiner may combine three or more signals, with each signal being independent of the other 5 signals and not effecting the input impedance.

The wave device may also be used as a splitter by providing a power input at the output of the wave device and receiving divided power output from the pairs of 10 inputs.

The invention will be more clearly understood from the following description, given by way of example only, with reference to the accompanying drawings, in which:

15

Figure 1 illustrates a known 2-way Wilkinson combiner;

Figure 2 illustrates an embodiment of the present invention;

20

Figure 3 illustrates a cross-section through the embodiment of Figure 2;

Figure 4 illustrates the microstrip layer of a divider;

25

Figure 5 illustrates a microstrip layer of a matching circuit;

Figure 6 illustrates the frequency response of an embodiment of the present invention with both amplifiers working and with a failed amplifier; and

30

Figure 7 illustrates a frequency response of an embodiment of the present invention with both amplifiers working and with a failed amplifier.

An embodiment of a 2-way combiner will now be

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Any suitable material may be used for the dielectric 30. Indeed, if the plate 28 is appropriately supported, for instance by means of its connecting pins, then the dielectric 30 may be a gas, such as air, or indeed free  
5 space.

It is also contemplated to base the device on Gallium Arsenide or such like and thereby allow production using integrated circuit techniques.

10

As illustrated, the output 20 is taken through the dielectric and also through and insulated from the support structure 32. Although not illustrated, a similar arrangement is provided for the inputs. These  
15 connect to the periphery of the plate 20, whilst being insulated from the support structure 32. Any ground line of the wave guides for the inputs, for instance the shielding of a coaxial cable, may be connected to the support structure 32.

20

The embodiment discussed above used a DMC of circular structure having two pairs of inputs and a centrally mounted output. However, as will be apparent from the following, such a structure is not necessary for  
25 application of the present invention. For instance, when using two pairs of inputs with perpendicular standing waves, the DMC, or at least the plate 28 in the microstrip embodiment, can be square with inputs mounted centrally along respective edges of the square.

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Referring to Figure 2, a broader description of the principles behind the present invention will be described.

35

By applying a signal to both inputs 10,12 across a

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device, it is possible to set up a standing wave across the device. The nature of that standing wave will vary according to the frequency of the input signal, the distance between the two inputs and the properties of the 5 wave device. In particular, the resonant frequency between the inputs will depend on the distance between them and, for the embodiment of Figure 3, the dielectric constant of the dielectric 30. For the same resonant frequency, the size of the device will be reduced as the 10 dielectric constant increases.

When a standing wave exists between the inputs 10,12, the signal which can be detected at the periphery of the device varies around the periphery. When the 15 standing wave between the inputs 10,12 is at the fundamental frequency, then the detected signal at the periphery of the device reaches a minimum of substantially zero at a position halfway between the inputs 10 and 12. Thus, for a 2-way combiner, it is sufficient to connect a 20 second pair of inputs perpendicular to the first pair of inputs. It will be noted that, in this case, with two perpendicular standing waves, it is therefore sufficient for the device to be square.

25 By changing the operating frequency of the device or alternatively changing the size or the properties of the device, it is possible to set up different standing waves. In particular, it is possible to set up standing waves such that the detected signal at the periphery 30 reaches substantially zero at multiple points around the periphery. In this way, it is possible to arrange three or more pairs of inputs around the periphery to provide a three or more-way combiner. Indeed, the device may then be any even sided polygon such as a hexagon, octagon etc.

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outputs from the Wilkinson divider. DMCs were initially simulated with both amplifiers working and then with one of the amplifiers failing. A failed amplifier was defined according to the worst case, namely (i) zero  
5 output power and (ii) the impedance of the failed amplifier, as seen from the divider, ranging from zero to infinity i.e. anything between short circuit to ground and an open circuit. The results of the test are illustrated in Figures 6 and 7. The output power from a  
10 working amplifier is one unit and the results obtained include the losses incurred by the Wilkinson divider, which has an efficiency of 90%.

Referring to Figure 6, using a 2-way Wilkinson  
15 divider for the first stage and a centre frequency of 1.8 GHz, it will be seen that, for both amplifiers working, the total combining efficiency at the centre frequency was 80%, with the worst efficiency within the operational band width being 78%. Similarly, for a single amplifier  
20 failure, the total combining efficiency at the centre frequency was 63% and the worst efficiency within the operational band width was 59%.

For the second case, illustrated in Figure 7  
25 utilising a 4-way Wilkinson divider and a centre frequency of 1.83 GHz, it will be seen that for both amplifiers the total combining efficiency at the centre frequency was 80% and the worst efficiency within the operational band width was 80%. Similarly, for a single  
30 amplifier failure, the total combining efficiency at the centre frequency was 63% and the worst efficiency within the operation band width was 54%.

In conclusion, it will be seen that the simulation  
35 results obtained show that the DMC has an efficiency

3/3

Fig.6.

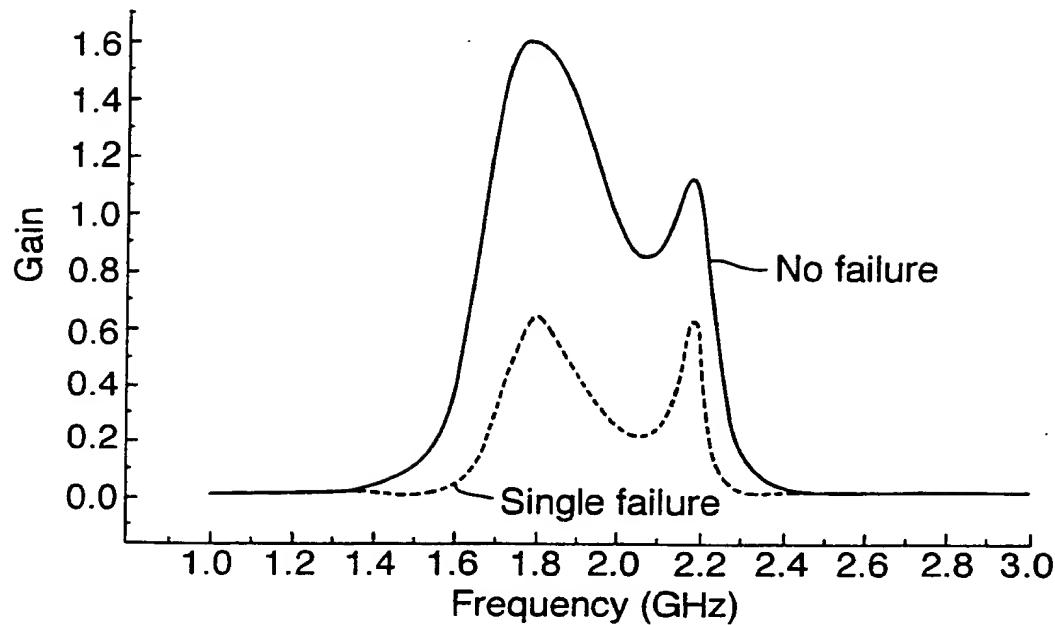
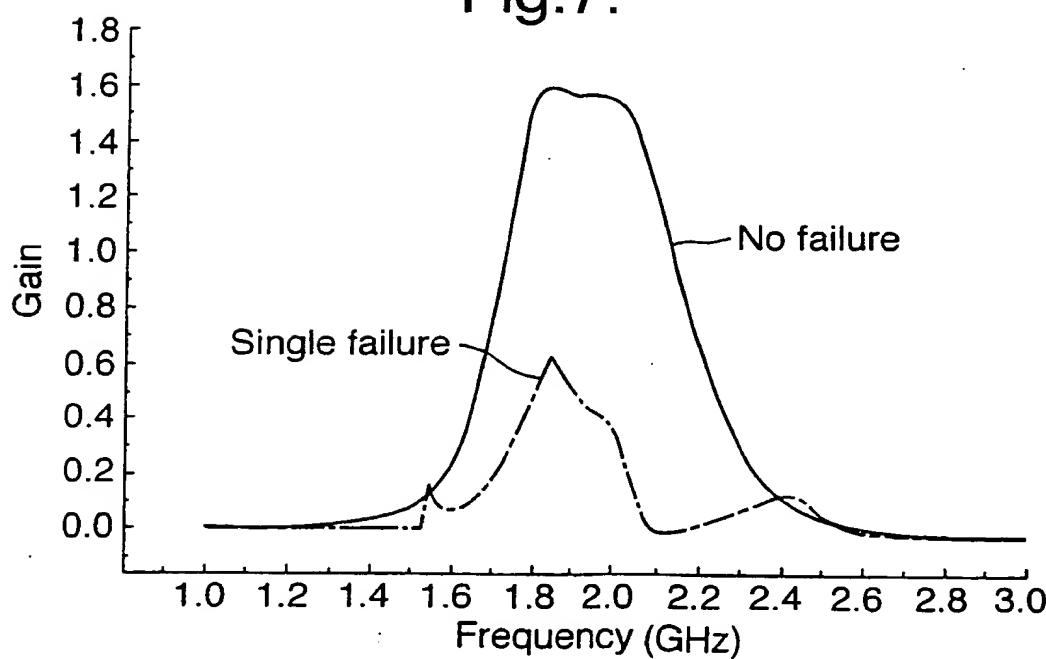


Fig.7.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/04047

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01P5/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H01P H03F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

PAJ, EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	M.D. ABOUZAHRA ET AL.: "MULTIPLE-PORT POWER DIVIDERS/COMBINERS CIRCUITS USING CIRCULAR MICROSTRIP DISC CONFIGURATION" 1987 IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM-DIGEST, 9 - 11 June 1987, pages 211-214, XP002181722 Las Vegas (US) page 211, left-hand column, line 14-40 page 212, right-hand column, line 18-25 page 213, right-hand column, line 21-27; figures 1,2	1-16, 18-22

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## \* Special categories of cited documents:

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Date of the actual completion of the international search

1 November 2001

Date of mailing of the international search report

13/11/2001

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## INTERNATIONAL SEARCH REPORT

International Application No

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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 065 (E-388), ✓ 14 March 1986 (1986-03-14) & JP 60 216602 A (NIPPON DENGYOU KOUSAKU KK), 30 October 1985 (1985-10-30) abstract ---	1,11,15, 21
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 319 (E-450), ✓ 30 October 1986 (1986-10-30) & JP 61 128604 A (HITACHI LTD), 16 June 1986 (1986-06-16) abstract ---	1,11,15, 21
A	E. BELOHOUBEK ET AL.: "30-WAY RADIAL POWER COMBINER FOR MINIATURE GAAS FET POWER AMPLIFIERS" 1986 IEEE-MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM-DIGEST, 2 - 4 June 1986, pages 515-518, XP002181723 ✓ Baltimore (US) page 515, right-hand column, line 5-17; figure 1 ---	1,11,15, 21
A	K.C. GUPTA ET AL.: "ANALYSIS AND DESIGN OF FOUR-PORT AND FIVE-PORT MICROSTRIP DISC CIRCUITS" IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES., vol. 33, no. 12, December 1985 (1985-12), pages 1422-1427, XP002181724 ✓ IEEE INC. NEW YORK., US ISSN: 0018-9480 page 1424, right-hand column, line 10 -page 1525, left-hand column, line 10; figures 8,9 ---	1,11,15, 21

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 01/04047

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 60216602	A 30-10-1985	NONE	✓
JP 61128604	A 16-06-1986	NONE	✓

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